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A CONTRIBUTION TO THE STUDY OF TUMORS OF THE SPINAL CORD

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A CONTRIBUTION TO THE STUDY OF TUMORS OF THE SPINAL CORD.*

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THE study of tumors of the spinal cord and of its meninges has been considerably neglected of late years. This neglect must be attributed in part to the general belief (which I shall not be able to discredit) that it is difficult to establish a differential diagnosis between tumor and other chronic affections of the spinal cord, and that the close study of these tumors is, therefore, of little *practical* value. No less an authority than Erb[1] expresses this opinion. The difficulties become still greater when we attempt to differentiate clinically between tumors of the spinal meninges and tumors of the spinal-cord substance. The latest authors on this subject, (Drs. C. K. Mills and J. Hendrie Lloyd[2]) have abandoned the attempt altogether. The great interest now being felt in syringomyelia will probably direct attention once more to the symptomatology of spinal tumors, for there is no doubt that there is an inti-

* A preliminary report on the case here reported was made before the N. Y. Neurological Society at the stated meeting, April 6, 1886. Numerous other duties have prevented the earlier publication of this paper.

[1] Ziemssen's Handbuch. Erb: "Diseases of Spinal Cord," vol. xi., 2, p. 340, Germ. ed.

[2] Pepper's System of Medicine, vol. v., p. 1091.

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mate clinical (and probably also pathological) relation between these two forms of spinal disease.

Those who will not be satisfied to pursue clinical studies unless some practical good shall be the outcome of such studies, should recognize the importance of differentiating for purely therapeutic reasons, if for no other, between chronic transverse myelitis, for instance, and tumor. Every case of tumor of the spinal cord, if verified by post-mortem examination, may help to clear up the mystery surrounding the symptomatology of these diseases. The case which I propose to discuss has special claims upon our attention for the following reasons. 1. It was a tumor of the spinal-cord substance without involvement of the spinal meninges. 2. The tumor gave rise to the first and most prominent symptoms of a general tubercular diathesis. 3. The myelitis following in its wake was of unusual severity. 4. The case presented unusual sensory symptoms.—First, as to the history of the case:

F. F., aged thirty-two, a man of considerable intelligence, unmarried, a dealer in bric-a-brac, presented himself at the Polyclinic for the first time on February 7, 1886. He complained of pains and weakness in his left arm, of inability to move the fingers, and of the glossy appearance of this left hand. The man was made the subject of a clinical lecture, in the course of which I elicited the following details: He was born in Brussels, where he lived until he came to this country six and a half years ago. His mother had epileptic fits consequent upon a severe mental shock; cause of her death unknown. The father, a physician, was a heavy drinker, and died at the age of forty-two; some heart trouble the immediate cause of *his* death. The patient has several sisters and brothers, all of whom are enjoying good health. Patient himself had typhoid fever when six years old; no venereal diseases, except gonorrhœa; syphilis absolutely denied; acknowledges excessive sexual and alcoholic indulgence for many years; he was in the habit of drinking daily from twenty to thirty glasses of beer, and had a special fondness for absinth. Two years ago he had a severe attack of articular rheumatism, which affected all

the joints of his extremities, and kept him in bed for some weeks: states that he has had rheumatic pains ever since.

History of Present Trouble.—Four weeks ago (about January 8th) he felt what he termed rheumatic pains in the left shoulder; these moved down to the left arm; the hand grew weaker after the lapse of a week or more, and as the weakness increased, the fingers became puffy and the skin glossy.

Present Condition.—Feb. 7th.—The patient has a gluttonous and rather bloated look, but otherwise of excellent physique. On comparing the two arms, we observed that both arms could be raised above the head, but in dropping them the left arm dropped more readily than the right; the upper arm and forearm offered considerable resistance to passive movements, and were in marked contrast to the muscular power of the hand and fingers, which was almost nil; the fingers were slightly flexed; voluntary extension or further flexion was impossible. The sensory disturbances were even more marked; there was hyperæsthesia of the entire fore-arm and hand, which was greatest, however, over the distribution of the ulnar, and particularly over the outer dorsal surface. The mere touch with the finger was painful; the prick with the pin was so disagreeable that the æsthesiometer test had to be abandoned; cold water dropped on the arm produced excessive pain (this the patient had noticed in washing also). Pressure with the finger over ulnar and radial nerve was objected to, whether or not in consequence of the cutaneous hyperæsthesia, it is difficult to say. The vaso-motor or trophic symptoms noticeable during this first examination were a swelling of the skin *between* the joints of all the fingers of the left hand and a peculiar œdematous appearance of the skin of the entire hand including fingers. The electrical conditions were quite normal. Both nerves and muscles responded to faradic current of moderate strength; in consequence of hyperæsthesia this examination had to be made hastily. The galvanic reactions were entirely normal; no unusually weak or strong currents were required to produce contractions, and the order of contractions was not

reversed in the case of any nerve or muscle of the left arm. There was no ataxia in lower extremities; no incoördination of movements in right arm; superficial reflexes could not be elicited, except, possibly a very slight scrotal reflex on right side. The other parts of the body were subjected to a careful examination; there were no other symptoms discoverable, except these: 1. A slight dragging of the left foot, but no very marked diminution of gross muscular power, as tested when the patient was lying on his back. 2. An increase of both knee-jerks, and presence of ankle clonus on *both* sides. In view of this peculiar complexity of symptoms, a definite diagnosis was not attempted at this time.

In the course of the next two weeks I saw the patient at irregular intervals. During this time the symptoms in the left upper extremity remained unchanged. From February 15th on (about a week after first examination) the impairment of power in left leg became more noticeable; this increased until February 26th, when the patient could move the left leg with the very greatest difficulty only; resistance to passive movements almost nil; the loss of power was distributed equally over thigh and leg. The right leg remained normal. In addition to the other symptoms general hyperæsthesia of left leg had been developed, but the various forms of sensibility in *right* leg was in no wise impaired (tested with æsthesiometer points and cotton). Subjectively there was no pain in left leg, but a feeling of cold throughout the entire left lower extremity. These unilateral symptoms continued uninterruptedly until March 2d (three weeks after first examination).

In order to make a complete examination, I arranged to examine the patient at my leisure in the office. Up to Feb. 26th he had succeeded in walking about with the aid of a stick. March 2d he could walk about only with the support of a friend.

On this day, March 2d, his condition was noted as follows: no head symptoms; pupils equal, and react promptly to light and during accommodation; all ocular movements perfect; tongue straight when protruded; no dis-

turbances in articulation or deglutition; no headache; sleeps well; no atrophy of any muscles of body; can raise both arms fairly well, but left arm behaves as on first examination; no changes as regards either upper extremity since first examination; can still offer considerable resistance to passive movements with left upper arm and forearm; the fingers are completely motionless, possibly in consequence of pain, and swelling of the skin; no incoordination of movement of right arm; pricking of pin felt as distinct pain over distribution of l. ulnar nerve; a cold sponge passed over this area causes him to cry out with pain; fingers as puffy as ever; no reflexes to be elicited in this upper extremity. Faradic response from nerves and muscles fair to moderately strong currents; on this day galvanism was not tried. Left leg extremely paretic; he can stand on it without using stick, but in trying to move it requires additional support; his left leg, he states, feels like a piece of wood on a string, by which he means that it is entirely beyond his control; he cannot tell whether his foot is right in the shoe or not; there is continued hyperæsthesia of whole leg; patient stated to-day for the first time that his right leg is growing weaker also, and on examination resistance to passive movements in the leg is found to be diminished as compared with the condition of the right leg at the preceding examination; he complains also of weakness of abdominal muscles; cannot press properly when he goes to stool; sensation in right leg not disturbed at this time. The patient was urged to have himself taken into hospital; he had his own peculiar reasons for not wishing to go there. I ordered him to go home, and to remain strictly in bed, and put him on increasing doses of the iodides of potassium and sodium. I endeavored to have him as well cared for as his poverty-stricken surroundings would permit. I saw him again two days later, and found him, contrary to my orders, sitting upright in a chair, smoking a pipe, reading a French novel, and hopeful that he would be all right in a few days. With the aid of chairs he moved toward the bed; his left leg could barely be dragged along; sitting on the edge of the bed he was this

day able to swing himself around, and to lift the left leg into bed with the assistance of the right. The left arm in *statu quo;* fingers slightly flexed, but flexion can be easily overcome, though the mere touch of the fingers, and particularly of the finger-tips, causes intense pain. Forearm and hand tested again with æsthesiometer; number of points could not be readily distinguished, as the pain-impressions were predominant on entire dorsal and volar surfaces; cold water as painful as ever; left leg cannot be lifted at all from bed. Muscular sense grossly at fault; cannot estimate the distances to which left leg has been raised from bed; acknowledges his surprise when he opens his eyes and sees where his leg is; gauges the position of right leg very accurately; marked hyperæsthesia to touch or cold over entire left lower extremity; knee-jerks and ankle clonus about as before. One symptom which I observed this day deserves special notice. A plantar flexion of the left foot produced distinct contractions of the tibialis anticus; once or twice this flexion movement was followed by a distinct ankle clonus, which was therefore evoked in a way diametrically opposed to the customary method. This contraction of the tibialis anticus I was inclined to regard at the time as an instance of paradoxical contraction, though this contraction generally ensues when the extreme ends of a muscle are approached to one another, and not removed from one another as they are in this case. Prof. Westphal,[1] in a recent article on a curious group of symptoms associated with sclerosis of the posterior columns, refers to a paradoxical contraction produced in this way. I did not succeed in producing this phenomenon in the course of subsequent examinations.

March 9th.—No marked change in the symptoms as detailed above, except that incontinence of urine has set in; patient feels that he is growing worse. Left arm unchanged; left leg absolutely paralyzed, and the right growing rapidly weaker; is not well able to use his right leg in lifting the left into bed, as he was two days ago. While there is still marked hyperæsthesia of the left leg, there is no percep-

[1] *Arch. f. Psych.*, vol. xvi., 1885.

tible sensory disturbance on right leg. Muscular sense disturbed as above. On the trunk of the body, the limit of hyperæsthesia extended, exclusively on left side, as high up as level of third rib. Examined with electrical current again: no change in galvanic reactions, and faradic responses from nerves and muscles of all extremities prompt to currents of moderate strength; even the ulnar responded in this way.

March 11th.—A slight cough, which the patient has had for a few days past, begins to annoy him as he has not sufficient muscular power to expectorate freely. Lungs and heart examined as carefully as the now helpless condition of the patient would permit: there were the usual catarrhal râles but no other physical signs of any import could be made out; the action of the heart was rather feeble, but sounds were clear. The paralysis has markedly increased; the patient is totally unable to move himself in and out of bed; when raised in bed he complains of weak back; the head can be moved well from side to side, but not so well from before backward. There is some tenderness on pressure over the seventh cervical vertebra, and when the head is moved backward the pain is stated to be at the level of the vertebra and along both trapezii. The left hand unchanged; but the grasp of the right hand is far weaker than it was, and the patient states that there is now also a numbness over the dorsal surface of right forearm. No puffiness of the fingers of the right hand; the right leg has become very much more paretic; even this leg can now be lifted but three or four inches from the bed; the muscular sense, as tested by raising leg from bed, is beginning to be impaired on right leg also; the hyperæsthesia of left leg and of the left side of trunk as high up as seventh rib is giving way to loss of tactile sensibility; there is an area of hyperæsthesia still between seventh and third rib on left side. Tactile sensibility of back well preserved. Tenderness to touch most marked on the outer dorsal aspect and the whole of the volar surface of the forearm. Touching fingertips with pin produces intense agony. (Eyes remain closed during test). Warm water applied to back does not excite

pain at any particular point. No bed-sores though there is slight reddening of skin over sacrum. Weight-sense was tested without any satisfactory results. Bowels have not moved in several days. Two days later, the only changes noticeable were the increasing paresis, amounting to complete paralysis of right leg, and a suspicious redness of the skin over the internal malleolus of the right foot, against which the left foot had pressed. Knee-jerks are still exaggerated, though not as markedly so as they were; ankle clonus is not as easily excited as in the past.

The day following, March 14th, I invited Dr. Starr to visit the patient with me. Our notes made independently agreed in all particulars and brought out the following facts regarding disturbances of sensibility. The hyperæsthesia had given way still further to a gradually increasing anæsthesia to touch; while the hyperæsthesia had been confined exclusively to the left extremities and to the left half of the trunk, the anæsthesia now involved both sides of the body, but not all parts equally; the only parts which at this time retained normal sensation were the neck, face, and head. Left arm and hand: persistent hyperæsthesia to mere touch, to hot and cold; cold produced the greater pain; warm was painful also but was recognized as "warm" (in these tests, a silver spoon dipped alternately into hot and cold water was used). Left leg: sensation to touch below the knee almost wholly abolished; above the knee very nearly abolished; light touch of the finger and stroking with cotton were not perceived; the finger drawn across thigh was felt and direction in which it moved was correctly stated. The following day touch of finger was perceived on dorsal surface of both feet; hot or cold could not be appreciated.

Temperature sense distinctly altered; heat was not felt, cold produced pain; muscular sense (sense of position of muscles) entirely abolished. Right leg: sensations of touch and of pain more acute than in left leg, but less acute than in right arm and in face. Heat could not be appreciated while cold was painful; muscular sense far better than in left leg, but nevertheless considerably impaired. Trunk:

left side, which was at one time hyperæsthetic, has had its sensation to touch and pain somewhat dulled; the cotton and pin tests were felt, and correctly located, but were not as distinctly felt as on the right side of the median line. Heat and cold could not be appreciated as such on left side, but were recognized on right side. Scratching left side of abdomen with a pin produced more redness than on right side. R. arm: much more sensitive to touch than left, yet the sensations were not as acute as on the neck and in the face. Muscular sense well preserved. In left arm it could not be tested, as the mere attempt to move any finger or the whole hand was exceedingly painful. Next day, no distinct tenderness could be perceived over any part of spinal column; cotton was perceived equally on both sides of back. The motor disturbance had increased to a complete paraplegia; in the l. upper extremity grasp of hand and all movements of hand almost nil, but patient retained considerable power in the pectoralis, deltoids, biceps, and brachialis; grasp of right hand much weaker than it has been; abdominal muscles almost powerless and action of inspiratory muscles of thorax very weak; complete relaxation of muscles of back; head could be moved freely in all directions; all ocular and facial movements perfect. The knee-jerks and ankle clonus not as marked as they were; cutaneous reflexes could not be elicited.

I saw the patient again and for the last time two days later. No marked change had taken place. I took occasion to make an ophthalmoscopic examination of the eyes which I neglected to do in the earlier history of the case, but could detect no important changes. I may say again that the man continued reading in bed until a few days before death, and in answer to my questions invariably stated that vision was good. A few statements, which were not included in this chronological record of the case, will help to complete the history. The temperature was taken at different times during my visits and was never found to have exceeded 99½° in the axilla; this would of course not exclude possible rise of temperature at other times; my visits were made generally late in the evening. Pulse small

and accelerated, often about 120. Respiration varied very much, generally about 25; on the last day I saw him they had gone up to 45. The urine was examined several times and found free from sugar and albumen. There was no distinct history of night-sweats; but according to his statement the patient had for a long time been subject to unilateral sweating of the right side. At the very first examination the beads of perspiration on the right side had attracted my notice.

The patient's objections to being taken to a hospital were finally overcome, and he was removed Wednesday, March 17th, to the German Hospital. He arrived there feeling weak, but not particularly exhausted. On Thursday morning about seven o'clock, he asked his neighbor in the ward to read a newspaper to him; while this was going on, the patient died, and quietly at that, for his neighbor continued reading until an attendant who stepped up to the bed found the man dead.

Summarizing the main points in the history of this case, we may say that the trouble, which was supposed to be rheumatic, began with pain in the left shoulder which radiated down into the arm; the pain became more intense, and for the first was confined chiefly to the area of the ulnar, spreading later on over entire dorsal and volar surface of left forearm and hand; in addition to this hyperæsthesia and to puffiness of the fingers, we found considerable weakness of grasp in the left hand, with only slight loss of power in the muscles of the arm, forearm, and shoulder. The condition of this left upper extremity remains unchanged during the whole course of the disease—a period of about two months. A slight paresis, some hyperæsthesia of the left leg, exaggerated knee-jerks and ankle clonus were the only other symptoms discovered during the first few weeks of the disease. These symptoms, chiefly unilateral, continued so until the close of the seventh week. Meanwhile the paresis of the left leg had developed into an almost complete paralysis, and the unilateral paresis is transformed in the eighth week to a complete paraplegia. The motor paralysis increasing affects also the abdominal muscles, and

to some extent the respiratory muscles and the right upper extremity. Incontinence of urine and bed-sores were superadded. As for the sensory disturbances, there was developed by degrees a general hyperæsthesia of the left half of the body below the level of the third rib ; this hyperæsthesia was changed later on into an anæsthesia which spread from the left half and finally involved the right leg and, to a lesser degree, the right half of the trunk and the right upper extremity.

Now as to the interpretation put upon these symptoms during life. That the symptoms of the last two or three weeks were those of a cervico-dorsal myelitis there could be no manner of doubt, but the troublesome question was to decide the origin of the myelitis and to explain the persistent hyperæsthesia and paresis of the left upper extremity, coupled as these were, strangely enough, with slight paresis of the left leg and with exaggerated knee-jerks and ankle clonus on both sides. With the exception of these reflex movements, all symptoms were strictly unilateral for nearly four weeks after first examination. At the outset I was inclined to the belief—and in view of the patient's rheumatic record it was not an irrational one—that his was one of those rare afflictions, so rare that their existence may still be questioned, of an ascending neuritis giving rise to a myelitis. I soon abandoned this diagnosis, for the condition of the electrical reactions and the slight amount of, and unequally distributed, paresis made one rather sceptical as to the existence of a *neuritis*, and I could not imagine a *myelitis* spreading across the cross-section of the spinal cord so slowly that it should for weeks give rise to unilateral symptoms only. It was my surmise that a lesion involving the posterior root-fibres of the lower cervical segments could possibly explain all symptoms, but to the nature of the lesion I had no direct clue. Giving patient the benefit of the doubt, from the wild life he had been leading I suspected the possible existence of a gumma in this vicinity, but the therapeutic results did not strengthen this suspicion. Tubercular disease, or any cachectic diathesis, I did not suspect; the physical signs were certainly not

marked enough,[1] and the general appearance of the man, a strapping fellow, did not point that way. The autopsy has cleared up the mystery, and after I have given a short account of the post-mortem appearances, it will be in order for us to inquire whether this case furnishes sufficient points for a differential diagnosis between tumor and other affections of the cord.

Post-mortem Examination.

The autopsy was made eight hours after death by Dr. Waldstein, pathologist to the Hospital; the microscopic examination of the cord was made by the writer.

The skull was thickened but symmetrical. The dura mater was easily detached from the brain, except over parietal vertex, where it was slightly adherent to the pia. The sinuses were well filled; the vessels of the pia were somewhat more congested than normally. All blood-vessels were found normal in structure. No hemorrhage into the brain-mantle or the subcortical ganglia, and no malignant growths anywhere in the brain. The convolutions were a trifle narrrow, but not otherwise changed.

No disease of the vertebræ. The spinal dura appeared entirely normal. The cord with its meninges was removed easily, except at its upper end. On opening the dural sac, a large amount of fluid escaped, and the vessels of the pia, along the entire length of the cord, were seen to be greatly congested. The lower portion of the cord exhibited no macroscopic changes except innumerable calcareous (not tubercular) deposits scattered over the pia of this portion of the medulla spinalis.

The chief trouble was evidently limited to the lower cervical and upper dorsal segments. *From the seventh cervical to the fourth dorsal segment* the cord appeared to be a diffluent mass, revealing no trace of structure. Throughout this softened portion of the cord, whitish nodules appeared to be scattered here and there. As soon as the cord was partially hardened it was evident that the myelitis

[1] The very frequent respiration in the latter stage of the disease might have been caused by direct interference with the respiratory nerves.

had involved the posterior columns, part of the gray matter, and a small portion of the lateral columns, leaving perhaps half of the area of the lateral columns intact, as well as the anterior (ventral) portion of this region of the cord. Between the sixth and seventh cervical segments (area determined by the character of the emerging root-fibres) we found a round tumor of the size of a hazel-nut pressing closely upon the emerging posterior fibres, without displacing these, and extending inward as far as the median line; at its caudal end the tumor had exceeded the median line by a small fraction of an inch. The dura and pia had been readily detached from the spinal cord at the level of the tumor. There were no visible changes in the dura or pia except that a few very small tubercular deposits were found in the pia over the middle dorsal region.

The *tumor* consists of an outer harder portion, encircling a soft, cheesy mass within. Inspection of the cross-section of this tumor in a comparatively fresh state, and later microscopical sections, proved this tumor to be a typical solitary tubercle of very respectable dimensions. Although the tumor takes up the entire thickness of the cord (dorso-ventrad), the amount of destruction is not as great in its immediate vicinity as it is at a level about one inch caudad of the lower end of the tumor. Unfortunately I am not able to state how far cephalad this myelitic process extended, for, on removing the cord, this part was somewhat (perhaps unavoidably) lacerated. It is surely speaking within bounds to say that the myelitic process stopped short at about the third cervical segment. On the fresh cord no positive evidence of ascending or descending degeneration could be discovered. A portion of the left ulnar, median, and radial nerves were removed for microscopic examination; but the result was an entirely negative one.

For the rest, the autopsy revealed very minute tubercular deposits scattered here and there throughout both lungs; in both apices there were incipient cavernous spaces; there were also old pleuritic and pericarditic adhesions. The valves and tissues of the heart proper were entirely normal. In the intestines there was evidence of a general miliary

tuberculosis. Spleen was enlarged ; liver and kidneys were normal. No evidence of alcoholism and none of syphilis.

The post-mortem diagnosis would read : General tubercular diathesis, with chief deposits in spinal cord, lungs, and intestines. In the spinal cord a solitary tubercle followed by a cervico-dorsal myelitis.

Microscopical Examination of Spinal Cord.

For this purpose the cord was suspended at once in Müller's fluid. It was watched most carefully, the fluid was changed frequently, and yet the hardening was not entirely satisfactory. The myelitic portion could not be rendered fit for cutting, and the exact amount of destruction could not be determined more accurately than in the comparatively fresh specimen. Fortunately, the symptoms to be referred to this cervico-dorsal myelitis were so clearly marked that a pathological examination could not have been expected to throw much light upon them. The rest of the cord, after it had been sufficiently hardened, was subdivided and the single segments imbedded in celloidin. The sections were then stained either according to Weigert's hæmatoxylin (old) method, or with acid fuchsin. Picrocarmine was used for sections through the level of the tumor. The sections most thoroughly examined were from the upper cervical, the mid-dorsal, and the upper lumbar levels.

Sections at the level of the tumor showed that the tumor not only occupied the entire left side of cord but that it exceeded the median line more than inspection of the fresh specimen had led us to suppose. With its lower (caudal) end it had insinuated its way into the posterior columns of the right half of the cord, leaving the columns of Burdach almost undisturbed. It had grown around the central canal destroying the greater portion of the commissural gray matter, but left the greater portion of the gray matter of the right side entirely unmolested. The lateral columns of the right side and the entire ventral half (gray and white) of the right side were normal. Of the tumor itself, of which sections were made and stained in picrocarmine, little is to

be said, as the appearances of a solitary tubercle are sufficiently well known and do not require accurate description.[1] The rest of the cord yielded the one negative fact that there were no traces to be found either of any ascending degeneration in the posterior columns or direct cerebellar tract above the level of the tumor, or of descending degeneration below the level. This fact was a great surprise to me. I can offer no other explanation but that the rapidly spreading myelitis effaced all traces of an ascending or descending degeneration. The myelitis was unusually severe and extensive, and before descending degeneration had time to follow upon the lowest level of myelitic change, death supervened. This explanation would not hold good if, as some authors would have it, degeneration, if it takes place at all, affects an entire system at once. But this whole question is still *sub judice.* (See Langley's Digest, *Brain*, April, 1886, and JOURNAL OF NERV. AND MENT. DIS., Aug., 1886, p. 496.)

Remarks.

It will now be our duty to review the clinical symptoms of this case in the light of the autopsy. In analyzing these symptoms it will be important above all things to differentiate between the symptoms due to the tumor and those due to myelitis.

The unilateral symptoms are to be placed entirely to the account of the tumor; the bilateral symptoms are the expression of myelitic changes, except that the extension of the neoplasm into the right half of the cord (surely a matter of the last few weeks only) may have given rise to sensory disturbances in the right extremities also. It is well in this connection to recall the following facts and dates: From Jan. 8th until March 1st the symptoms continued one-sided (the period of tumor symptoms); from March 1st to March 18th they were distinctly bilateral (the period of advancing myelitis). Unilateral symptoms during eight weeks, bilateral symptoms during two and a half weeks.

[1] The outer harder portion was characterized by small cells scattered here and there among the fibrous tissue; within the caseated mass there were found various cells in all states of decay, giant-cell formation, and a lot of detritus.

Regarded in this light, the symptoms would point to the fact that the myelitis spread almost as rapidly as any acute myelitis would. The question whether this myelitis was due solely to the presence of the tumor, or whether there was not possibly a tubercular myelitis in addition to the tumor and the myelitis directly caused by it, I must leave undecided for the present.

The tubercle was first deposited in the left half of the cord, at the level of the sixth or seventh cervical segment, and in the immediate vicinity of the posterior roots. The pains in the shoulder, which radiated down the arms (and possibly the vaso-motor symptoms), must be ascribed to irritation of the posterior root-fibres; that the ulnar should have been chiefly involved is not surprising in view of the spinal-cord origin of this nerve. With the growth of this tubercle—a relatively slow growth at best—there was a gradual increase in the paresis of the muscles of the left hand and fingers; as the tumor increased still further in size, it encroached upon the lateral columns, and caused a paresis not only of the left hand and fingers, but also of the left leg.

This slowness of growth is well proven by the fact that pains in the arms preceded the (motor) leg symptoms by several weeks, and that these motor symptoms progressed very leisurely during several weeks more, while the arm (ulnar) symptoms remained stationary. Pathological appearances would indicate that the tumor had occupied fully one half of the cross-section of the spinal cord. It would be fair to ask, Why (in this case) paresis and not complete paralysis of the left leg? A double answer might be given: First, in its slow growth the tumor displaced rather than destroyed the motor-tract fibres; and secondly, post-mortem appearances are apt to deceive us as to the number of fibres or amount of spinal-cord substance capable during life of conducting volitional impulses.

A similar explanation must be sought for the peculiar behavior of the sensory symptoms. I am now referring to those which preceded the onset of the distinctly myelitic symptoms. A tumor occupying one half of the cross-section

of the spinal cord would naturally interfere with conduction in that half of the cord; the symptoms following in its wake should be very much the same as those following upon hemisection of the cord, viz.: motor paralysis of the same side and anæsthesia of the opposite side. The doctrine of crossed anæsthesia from spinal-cord lesion, first enunciated by Brown-Séquard, has been confirmed an innumerable number of times; the facts of human pathology and the results of experimental physiology are entirely in accord with this view, not even Ferrier,[1] in his article on hemisection of the cord, having any fault to find with this portion of Brown-Séquard's views. In the face of so much corroborative evidence I should be loath to attempt a contradiction from the facts of a single case, however convincing such facts might appear to be. Moreover, if we assume that in my case the tumor increased very slowly in size, and that it pushed aside some instead of destroying all the sensory paths, the fact of a partial and not a complete anæsthesia will be satisfactorily explained. It is strange, however, that the side which, according to Brown-Séquard, should have been anæsthetic retained greater tactile sensibility at a time when the originally hyperæsthetic side had become anæsthetic in consequence of the spreading myelitis. I remind you of the statement in the notes of March 14th, that the sensibility to touch in the right leg, right half of trunk, and in the right upper extremity, though less acute than in the neck and face, was more acute than in the corresponding left members.

The behavior of the muscular sense calls for explanation also. On this point the views of Brown-Séquard and Ferrier are diametrically opposed to one another. According to the former, the muscular sense is abolished on the side of the lesion, while Ferrier's hemisection of the spinal cord of a monkey would go to show that the muscular sense is impaired on the side opposite the lesion. Ferrier says:[1] "The manifest difference between the use of the right (opposite) leg, with and without vision, clearly indicated the abolition of the sense of muscular contraction, and ina-

[1] *Brain*, vol. viii., 1885. [2] *Loc. cit.*, p. 4.

bility to appreciate the position assumed by the leg except with the aid of vision." When the animal was blindfolded, it was utterly unable to extricate its right leg from any opposition made to its intended movement; but if I understand Ferrier correctly, he makes no statement with regard to the leg on the same side as the lesion. The facts of my own case would argue in favor of Brown-Séquard's and against Ferrier,[1] for the patient exhibited in the earlier stages of his disease a grossly defective muscular sense on the left side, and normal muscular sense on the right side. Ferrier criticises Brown-Séquard for including under muscular sense simply the power to direct movements, and to this criticism I subscribe, for if Brown-Séquard were right, every paralyzed limb would necessarily be minus the muscular sense; but while I accept the same definition of muscular sense as Ferrier does (the sense of the position of the muscles, and knowledge of the manner in which any member has been moved passively), I find that in my case the muscular sense was abolished on the side of the lesion and not on the opposite side, as Ferrier would have it. We should come to some definite understanding regarding the use of the term muscular sense, and the tests to be applied in examining for the presence or absence of this form of sensibility. For the present we are grouping a number of heterogeneous phenomena under this term. This case certainly raises doubts whether all sensory fibres cross at once to the opposite side of the cord, and whether there be not sensory fibres in the lateral as well as in the posterior divisions of the cord. The other sensory phenomena observed in this case point to the necessity of a more careful study of the various forms of sensibility and their relations to spinal-cord lesions. As long as so little is known of the sensory parts of the spinal cord, I cannot do more than to refer to the eccentric condition of the temperature-sense, for instance, without attempting an explanation of

[1] Ferrier says: "So far as I have been able to discover by examination of the published cases of hemispinal lesion, the assertion that the muscular sense is lost on the side of lesion and retained on the opposite side, is not supported by any satisfactory evidence." Such evidence and such a case are here presented.

these facts. You will remember, for instance, that while heat was not felt as such in the lower extremities in the later stages of the disease, cold was distinctly recognized and produced a sensation of pain.

One other set of symptoms demands our attention. How can we explain the exaggerated knee-jerks and the presence of ankle clonus on both sides in the very earliest stage of the disease, at a time when there was only very slight paresis of the left leg and no paresis whatever of the right leg? Had the knee-jerk and the ankle clonus existed on the side of the tumor only, I should have said that the tumor during that period had been sufficiently large to remove some inhibitory influence without interfering much with the transmission of volitional impulses. It is barely possible that there may have been another small tubercle somewhere in the lateral column of the opposite side, and that this tubercle has been lost sight of in the vast destruction of cord tissue. In this connection I wish to recall the fact that Prof. Pitres,[1] of Bordeaux, published not long ago, a short article on the early appearance of ankle clonus in which he records two cases of hemiplegia in which ankle clonus was observed eleven and fifteen hours respectively after the onset of the apoplectic attack,—at a time, therefore, at which there could not have been degenerative changes in the lateral columns. If there be, as Langley suggests, commissural fibres connecting the lateral columns of one side with those of the opposite side, then lesion of one lateral column might remove enough cerebral inhibition from the opposite side to increase the deep reflexes on that side also. I question, moreover, whether the patient may not have had exaggerated knee-jerks and double ankle clonus before the onset of the disease. My suspicion is based upon observations I have made on a number of cases of neurasthenia from sexual and alcoholic excesses. In all of these cases I have found the knee-jerks markedly exaggerated; indeed I consider it a valuable symptom of the neurasthenic state, and can recall some cases in which I found even ankle clonus. It was stated above that no traces of chronic alcoholism were

[1] *Brain*, p. 310, 1885.

found *post mortem;* this, of course, referred to the condition of the large abdominal organs. That the long-continued abuse of liquor may have exerted its influence mainly upon the spinal cord, is more than likely. I prefer to leave this field of speculation. There are several plausible explanations,[1] and yet not one which is absolutely satisfactory. It is well for us to become conscious of the difficulties we may meet with in attempting to assign all clinical symptoms to their anatomical and physiological causes. With the exceptions just referred to, all other symptoms can be readily explained as dependent either upon the tumor or the subsequent myelitis.

The subject of tumor of the spinal cord is treated very briefly by our best authorities; Charcot and Erb giving the fullest account of the symptoms due to such lesions, while Leyden, Bramwell, Wilks, and even Strümpell and Ross pass the subject by in great haste. It would not be wise for me to attempt a full *résumé* of the entire literature of the subject, nor to analyze a large number of cases with a view to the differential diagnosis of tumors of spinal cord. This work has been well done by Dr. C. K. Mills and Dr. Lloyd, who have not only discussed the subject carefully but have tabulated fifty cases in the most painstaking fashion. In conclusion, only a few remarks, which will be designed to secure for this case its proper position in the rank and file of tumors of the spinal cord.

Extra-medullary tumors are by far more frequent than tumors of the spinal-cord substance; among intra-medullary tumors gliomata and tubercles[2] are more common than gummata, sarcomata, or cancerous growths. Our case was one of intra-medullary tumor. These are most frequent in the cervical and lumbar segments, to which our case does not

[1] Strümpell and Moebius, in a recent short article in the *Münchener med. Wochenschr.*, refer exaggerated deep reflexes to hyperexcitability (irritation) of the ascending (sensory) division of the reflex arc.

[2] This statement is contradicted by Mills' and Lloyd's table, but this is due to the fact that these authors do not distinguish between extra- and intra-medullary growths, and that they have tabulated *some* fifty cases and by no means *the* fifty cases of spinal tumor. Glaser (*Arch f. Psych.*, vol. xvi., p. 89) claims that tubercles have no great clinical interest, because they simply occur in the course of a general tubercular diathesis; in my case the spinal symptoms preceded the appearance of general symptoms by a period of nearly two months.

form an exception. The symptoms will naturally vary according to the position (level) of the tumor in the cord, and according to the histological character of the neoplasm. Extra-medullary tumors are generally characterized by pain in the back and by sensory disturbances due to compression of the posterior root-fibres ; in my case there was no lasting pain in the back, but there were marked sensory disturbances, for the posterior root fibres were affected by an intra-medullary tumor, so that this one point of differentiation between extra- and intra-medullary growths is not supported by my case.

The focal symptoms[1] will vary greatly according to the seat of the tumor ; there may be but slight sensory disturbances in a single area or in one limb ; the sensory disturbances may be unilateral ; and these may or may not be associated with partial, with unilateral, or bilateral paralysis. The number of symptoms may vary from one to a legion of such. The differential diagnosis can not well be referred to such an indefinite basis. Any set of spinal, and more particularly, hemi-spinal symptoms, whether of a motor, sensory, or vaso-motor order, if they be slowly progressive, might suggest tumor. There will be *good* reason to suspect tumor if there be in addition to some of the symptoms just referred to—some marked constitutional diathesis. In my case, I feel confident that no one who had seen the patient would have diagnosticated general tuberculosis, and I find that in one of two cases of tuberculosis of the spinal cord reported by Chvostek[2] some years ago, the tubercular diathesis was not diagnosticated during life, and the chief mischief was done, as in my case, in the spinal cord. The protracted course of the disease is supposed by some authors to be pathognomonic of tumor of the cord. The average duration is from six months to several years ; my case ran its full course in a little more than two months. Such statements as these could be easily multiplied to prove the difficulty in diagnosticating this special form of disease ; thus

[1] Indeed there may be no symptoms at all as in Simon's case. *Arch. f. Psych.*, vol. v., 1875.

[2] *Med. Presse*, 1873.

Richard Schultze,[1] a good observer, has recently published a case of tumor surrounding the cord from the cauda equina to the medulla oblongata, which was considered during life to be a case of myelo-meningitis. By a combination of favoring circumstances, I believe that a diagnosis of tumor of the spinal cord can be safely made; but in many cases, it will probably be, as Leyden says, a matter of chance whether or not the diagnosis can be made.

From my experience with this case, and my present knowledge of the literature of the subject, I should be inclined to make a diagnosis of intra-medullary tumor of the cord if a case presented motor, sensory, or vaso-motor disturbances over a limited area of the body below the head, if such symptoms remained unchanged or progressed during a long period of time, if these symptoms were followed after weeks or months by symptoms pointing to an advancing myelitis, and if there were reason to suspect some constitutional diathesis. In the case of extra-medullary tumors, evidences of disease of the vertebræ would greatly assist in establishing a diagnosis.

[1] *Arch. f. Psych.*, 1886, p. 592. A similar mistake was made by Friedreich in the case reported by Schultze. *Arch. f. Psych.*, vol. viii., 1878.

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